

SOIL BASED MATERIAL AND METHOD FOR PRODUCING SAME

This invention relates to the load bearing qualities of soil and soil based materials, including the behaviour of soil and soil based materials when subjected to impact loading. The invention is particularly concerned with providing a soil based material having improved load bearing qualities, and is also concerned with the method of producing such a material.

In the context of this specification a "soil based material" is to be understood as a material including soil and at least one additive mixed with the soil. Such a material may or may not provide a growing medium for grass and/or other forms of plants. It is to be also understood that the term "soil" includes sand as well as sand composites such as a mixture of sand and clay, or a mixture of sand and organics, by way of example.

It is known to attempt to improve the strength of soil by providing a mixture of soil and a fibrous or other strengthening component. One such proposal is the subject of Australian patent 586766. Other prior proposals are briefly described at pages 2 and 3 of the specification of AU 586766.

Prior proposals of the foregoing kind have not been successful for a variety of reasons. One common problem is compaction of the surface during use, and as a consequence the surface no longer satisfies the required performance standards. Another common problem is inadequate drainage, which also leads to a reduction in performance.

It is an object of the present invention to provide a soil based material that at least alleviates the aforementioned problems. It is yet another object of the invention to provide a soil based material having a composition that can be varied to suit a particular use of the material, or a particular circumstance of use of the material. Still another object of the invention is to provide a method of producing a material of the foregoing kind. Yet another object of the invention is to provide a method of maintaining the surface of material of the foregoing kind so as to maximise the performance of that surface when in use. An object of the invention in a preferred form is to provide a soil based material that promotes growth of grass or other vegetation by retention of nutrients and other fertilisers, air and water, whilst at the same time promoting good drainage of excess water.

A soil based material according to the present invention is characterised in that it is composed of or includes a soil matrix and fibres scattered throughout that matrix. The fibres may be synthetic fibres (eg., fibreglass), or naturally occurring fibres such as animal, plant, or vegetable fibres, or a mixture of synthetic fibres and naturally occurring fibres. In the case of synthetic fibres, they may be mono fibres or fibrillated fibres, or a mixture of mono and fibrillated fibres.

Biodegradable fibres such as plant or vegetable fibres may be used in circumstances where the fibres are required to have a temporary influence. By way of example, they may be required to function as a binding agent until development of a substitute, such as the root structure of grass grown on the soil based material. A mixture of flax fibre and synthetic fibre has been found useful in some applications, and the synthetic fibre content may be minor by comparison with the flax fibre content.

In the context of this specification a mono-fibre is a single filament or single strand fibre. A fibrillated fibre on the other hand is supplied in flat ribbon-like form that splits and tends to expand into an open mesh-like structure when stretched laterally. That is, the flat ribbon includes a number of interconnected strands arranged so that when the fibre is stretched laterally the strands form an open mesh structure similar to that of expanded metal.

The fibres can be of any length and cross-sectional size to suit particular circumstances of use. By way of example, in one application of the present invention mono-fibres approximately 38mm long and having a cross-sectional size equivalent to 8 denier or thereabouts have been used successfully. In another application, 8 denier mono-fibres approximately 19mm in length have been used successfully. Longer fibres (eg., 38mm) are usually preferred if grass is not grown on the soil based material. Shorter fibres (eg., 19mm) are usually preferred if grass is grown on the soil based material, in this regard fibres having a length in the range of between 15mm to 20mm inclusive are particularly preferred. The length and/or cross-sectional size may vary however, to suit different applications and/or different circumstances of use of the material. Fibres having a length of 50mm, or greater, could be employed. Fibrillated fibres in the size range 700 to 1000 denier have been successfully employed, but fibres outside of that size range may be satisfactory. Once again

different applications and/or different circumstances of use can be a determining factor.

The stability of a fibre is an exponential function of its length. By way of example, if the length of one fibre is half that of another fibre, the stability of the first mentioned fibre may be as little as one tenth, or even one hundredth, the stability of the second mentioned fibre.

The fibres are preferably dispersed substantially evenly throughout the soil matrix. It is also preferred that the fibres are separated to an extent such that there is minimal tendency for them to congregate and form discrete clumps or bunches that are scattered in spaced relationship throughout the matrix. One method of avoiding or minimising bunching of the fibres includes inducing an electrostatic charge into the fibres so that they have a natural tendency to separate as they are fed through a blower/impeller system towards a storage zone or the soil matrix. Other techniques could be adopted to achieve the same result.

The soil matrix preferably includes an additive or additives other than the fibres. By way of example, the soil matrix may have an organic material such as sawdust, wood chips, bark pulp, or potting mix (to name a few examples only), dispersed throughout. Such a mixture may be adopted whether or not the soil based material is intended to provide a growing medium for grass, for example. In either case, the purpose is to retain moisture within the soil based material. If the material provides a growing medium for grass (for example) the moisture assists in growing the grass. If the material does not provide a growing medium for grass (for example) the moisture assists in bonding the sand granules or other soil particles.

For some applications of the soil based material, that material may also include an additive in the form of particles of a resilient material (eg., foamed polyethylene) scattered throughout the soil matrix. It is preferred that there is a substantially regular dispersion of the particles throughout the matrix. Such an additive is beneficial in circumstances where the soil based material is to be used as the surface, or as a surface layer, of an area that will be subjected to scattered impact loads. By way of example, such impact loading is encountered in sports fields and sports tracks, and is also encountered in farm tracks, animal holding yards, calving paddocks and animal drinking or feeding

areas. It is usually preferred that the material of which the resilient particles are formed is selected so as to have a high rate of recovery when distorted, and a low propensity to collapse.

5 It will be convenient to hereinafter describe the invention in greater detail by reference to one example application of the soil based material. It is to be understood however, that the soil based material has other applications, and that the composition of the material may vary according to its intended application.

10 Figure 1 is a preferred example embodiment of the soil based material in diagrammatic form.

Figure 2 is a preferred embodiment of a multi-stage blower system in diagrammatic form.

Figure 3 illustrates a preferred example embodiment of a mixing machine in diagrammatic form.

15 Figure 4 is an example preferred embodiment of the surface of the roller in diagrammatic form.

Figure 5 illustrates in diagrammatic form one preferred embodiment of mulching apparatus for producing particles.

20 Figure 6 is a preferred embodiment of a blade from the apparatus shown in Figure 5.

Figure 7 is a cross-section in diagrammatic form of the apparatus from Figure 5.

Figure 8 is a detailed view of the sieve from Figure 7.

25 Figures 9 and 10 are preferred embodiments of the sieve in plan from Figure 7.

Figure 11 illustrates in diagrammatic form one possible arrangement of a drainage system for use with the soil based material illustrated in Figure 1.

Figure 12 illustrates in diagrammatic form a preferred tread pattern.

30 Figure 13 illustrates in diagrammatic form a multi-series arrangement for tread patterns illustrated in Figure 12.

Figure 14 illustrates a preferred embodiment of the apparatus for laying the soil based material.

Figure 15 illustrates a manifold separating the separation means from the mixing chamber.

Figure 16 illustrates in diagrammatic form a preferred embodiment of a height adjusting means.

Figure 17 illustrates a preferred embodiment of the storage means.

Figure 18 illustrates a preferred embodiment of soil mixing discs.

5 Figure 19 illustrates an alternate preferred embodiment of the apparatus for laying the soil based material.

Figure 20 illustrates in diagrammatic form a preferred embodiment of the feed auger and separation means.

10 Figure 21 is an isometric view in diagrammatic form of an alternate form of apparatus for producing particles.

Figure 22 is a cross sectional view of the alternate form of apparatus for producing particles from Figure 21.

15 One example use of the soil based material is in forming the running surface of a track used for horse races or similar events. The example embodiment of the invention hereinafter described in detail is only one of several embodiments that may be used for that purpose.

20 The running surface of a race track incorporating an embodiment of the invention may be composed of two or more layers. In the example shown in Figure 1 of the drawings there are three layers – a surface layer 1, an intermediate layer 2, and a base layer 3. Each layer may have a thickness selected to suit the particular circumstances of use, but in one example that has performed well in practice each layer is approximately 50 mm thick.

25 The upper layer 1 includes a soil matrix 4 and a substantially regular dispersion of fibres 5 within that matrix. If the layer 1 is intended to provide a growing medium for grass (for example), the soil based material may also include organic material as hereinbefore described distributed substantially regularly throughout the matrix. The amount of organic material used can be selected to suit particular applications and circumstances of use. In the example hereinafter described it is preferred that one cubic metre of the soil
30 (eg., sand) and organic material composite includes approximately 0.04 cubic metres of the organic material.

It is also preferred that, in at least some embodiments of the invention, a wetting agent is applied to the sand so as to promote retention of moisture within the soil matrix. If desired, a tackifying agent may be included with the

wetting agent so that a moisture retaining crust is provided over the sand granules.

Any suitable method may be employed in producing the surface layer 1. Preferably that layer includes organic material as previously described, and a substantially homogeneous mixture of the soil matrix 4 and the organic material is preferably produced before adding the fibres 5. It is further preferred that the fibres 5 are deposited onto a surface of that homogeneous mix, after which an appropriate mixing process is adopted to achieve a substantially regular distribution of the fibres 5 throughout the soil matrix 4. The fibres 5 may be in a moist or dry state as they are being deposited onto the surface of the soil matrix 4. Regardless of the state of the fibres 5 however, the surface of the matrix 4 may be moist to promote retention of the fibres 5 on that surface.

It is preferred that the fibres 5 are subjected to a separation treatment prior to being mixed with the soil matrix 4. The purpose of such treatment is to avoid or minimise bunching of the fibres 5 such as to lead to the presence of discrete relatively dense separated groups of fibres 5 within the soil matrix 4.

The separation treatment may include passing the fibres 5 through a blower/impeller system which is arranged to encourage separation of individual fibres. An example system of that kind is illustrated in diagrammatic form by Figure 2 of the drawings accompanying this specification.

Figure 2 illustrates a multi-stage system involving use of at least two blowers – a first stage blower 7 and a final stage blower 8. It is preferred, as shown, that at least one intermediate stage blower 9 is positioned between the first and final stage blowers 7 and 8. Figure 2 shows three intermediate stage blowers 9, but the number could be less or greater according to requirements. As shown, it is also preferred that the final stage blower 8 is of larger capacity than each of the preceding blowers 7 and 9. Each of the blowers 7 and 9 may be of substantially the same capacity, but that is not essential.

Relatively small blowers 7 and 9 are preferably used in the initial stages so that a relatively small volume of fibres 5 is treated during passage through each of those blowers 7 and 9. That is intended to enable maximum separation of individual fibres. A larger final stage blower 8 is considered desirable to maintain, and possibly improve, the separation achieved within the preceding blowers 7 and 9. In the arrangement shown, the final stage blower 8 directs the

separated fibres 5 into a storage compartment 10. It is possible however, to adopt a different system in which the fibres 5 are moved directly from the blower 8 for deposition on, or mixing with, the soil matrix 4.

It is preferred that the separation treatment is arranged in a manner such that the fibres 5 become electrostatically charged during that treatment. By way of example, in the Figure 2 arrangement, such a charge may be induced during passage of the fibres through the blowers 7, 9 and 8, and/or during passage through ducts interconnecting those blowers. In addition, or in the alternative, the chamber 10 may have ribs or other projections 11 or surfaces over which the fibres 5 move so that an electrostatic charge is induced through frictional engagement. It will be appreciated that other techniques could be employed to achieve the desired result.

The purpose of the electrostatic charge is to assist the separation process. The combined influence of the electrostatic charge and the blower induced movement of the fibres 5 encourages lateral separation of the fibres 5, and also encourages the fibres 5 to move longitudinally through the system. That is, the longitudinal axis of each fibre 5 extends generally in the direction of movement of the fibres 5.

It has been found that relatively fine fibres (eg., 8 denier or more) tend to retain a relatively high electrostatic charge. On the other hand, finer fibres of less than 8 denier can be satisfactorily employed.

Fibres 5 may be extracted from the chamber 10 and delivered to the surface of the soil matrix 4 through a delivery duct system 12. A duct system 12 of substantial length may assist in enabling convenient handling of material. By way of example, ducting 40 to 50 metres in length has been used successfully. Alternative to delivering the fibres 5 direct to the soil matrix 4, the system 12 may deliver the fibres 5 to individual storage containers (not shown) or to a compartment of a spreading device (not shown). In any event, the system 12 may be arranged to maintain or reinforce the electrostatically charged state of the fibres 5.

The fibres 5 could be a mixture of different fibres. By way of example, a substantially 50/50 mixture of mono-fibres and fibrillated fibres has been found to be particularly satisfactory in some applications. The mono-fibres provide a hair-like structure and function as a binding agent within the soil matrix. The

fibrillated fibres on the other hand introduce another quality into the mix such that the soil matrix is able to move under load and absorb shock. That arises out of the fact that a fibrillated fibre can change its dimensions under impact. Such a fibre will respond to impact by widening in a lateral direction and
5 reducing in length. When the load is removed, the fibre will tend to return to its initial width and length. It is generally preferred to produce a substantially homogenous mix of the mono-fibres and the fibrillated fibres prior to introducing the fibres to the soil matrix 4. It is also preferred to mix the fibres prior to
10 subjecting the fibres to the separation treatment described above.

In one application, it has been found that satisfactory results can be obtained with a soil/fibre mix including 1 to 6 kilograms (preferably 2.6 kilograms) of a 50/50 mix of mono and fibrillated fibres in each cubic metre of the soil matrix 4. By way of comparison, if mono-fibres alone are used for the same or similar application, a fibre content of approximately 17 kilograms per
15 cubic metre of soil matrix may be required.

Various techniques can be adopted for depositing the fibres 5 and mixing the fibres 5 with the soil matrix 4. By way of example, the fibres 5 may be deposited manually or by a machine aided process. In either case however, it is preferred that appropriate measures are taken to ensure that the quantity of
20 fibres 5 deposited per unit area of the soil matrix surface is substantially consistent. By way of example, the soil matrix surface may be divided into a number of sections of a substantially equal size by way of a grid pattern, and a measured quantity of fibre 5 may be deposited on each of those sections.

In an alternative arrangement, a spreading device may be moved over
25 the surface of the soil matrix 4 at a predetermined speed, and operated to deposit fibres onto that surface at a predetermined rate of deposition. The speed of travel of the spreading device may be related to the rate of fibre deposition so as to achieve the desired spread of fibres 5 per unit area of the surface. Other techniques could be adopted to achieve the same result.

30 The deposited fibres 5 can be mixed with the soil matrix 4 by any suitable process, including manual or machine aided processes. In one example method a rotary disc hoe or similar machine, is employed to mix the fibres 5 into the soil matrix 4.

Figure 3 illustrates in diagrammatic form an example mixing machine 13 which may be tractor drawn or otherwise moved across the fibre coated surface 14 of the soil matrix 4. The machine 13 may include a series of rotatable discs 15, or other suitable blades, the rotational axis of which extends transversely, or angularly, relative to the direction of travel of the machine 13. The discs 15 are arranged to penetrate into the soil matrix 4 and are rotated as the machine 13 moves over the surface 14. In the example arrangement shown, the direction of rotation of the discs 15 is such that they lift the fibres 5, generally with some of the soil, and deposit those fibres 5 (and soil) rearwardly of the series of discs 15 into a furrow or depression 16 created by the rotating discs 15.

It is preferred that a freely rotatable roller 17 is drawn behind the machine 13 and is arranged to restore the surface 14 to a substantially flat and level condition. Any suitable roller 17 may be used for that purpose, including a roller having a smooth cylindrical surface. According to one example, the cylindrical surface of the roller 17 is formed by a series of intersecting bars or ribs 18 arranged to form an open-mesh structure as illustrated diagrammatically in Figure 4. The ribs 18 may extend around a shield or solid internal structure of the roller 17 so that soil cannot pass through the mesh openings 19 to the interior of the roller 17.

Thorough mixing of the fibres 5 and soil matrix 4 may be achieved in a single pass of the machine 13. In some applications however, a greater number of passes (eg., 10 or more) may be required.

The intermediate layer 2 preferably includes a soil matrix 4 and dispersed fibres 5 as described above in relation to the surface layer 1. It also preferably includes resilient particles 20 distributed throughout the soil matrix 4 in a substantially regular manner. The resilient particles 20 may also be located in the upper layer 1 however this is not essential. The resilient particles 20 are preferably added to the soil matrix 4 prior to or simultaneous with addition of the fibres 5, and any suitable method may be employed to achieve a substantially regular distribution of the particles 20 throughout the mix. By way of example, the particles may be mixed into the soil matrix 4 by a technique the same as or similar to the technique used to mix the fibre with the soil.

The particles 20 may be formed of foamed polyethylene (open or closed cell) or any other suitable material. According to one method, the particles are

created by passing a sheet or block of the selected resilient material through a hammer mill or other impact device operable to reduce the sheet into separated particle form. Alternative to impact shredding of the resilient material, sheets or blocks of the selected material may be divided into separated particle form by a cutting operation. By way of example, a hammermill-type of device having cutting blades instead of impact hammers may be employed. Cutting as distinct from impact shredding has the benefit of minimising the extent of which the particles have less elasticity than that of the sheet or block from which they are formed. Other techniques could be used, but it is preferred that the selected technique produces relatively small rough surfaced particles. In the case of sheet material, it is preferred to use sheets of approximately 3mm thickness if impact shredding is employed. Thicker sheets or blocks of material can be used if a cutting technique is employed.

Figure 5 illustrates, in diagrammatic form, one type of apparatus for producing the particles 20. In that example apparatus a series of discs 21 are mounted on a rotatable drive shaft 22 so as to rotate with that shaft. As shown, the discs 21 are arranged in axially spaced relationship. The number of discs 21, and their axial spacing, may be selected to suit requirements. A group of cutter blades 23 is provided between each two adjacent discs 21, and in the arrangement shown each blade 23 in each group is rotatably mounted on a respective pivot shaft 24. Alternatively, the pivot shafts 24 could be omitted and each blade 23 could be pivotally connected to an appropriate one of the discs 21 in any suitable manner. In the particular arrangement shown, each blade 23 is located between two spacer tubes 25 mounted on the respective pivot shaft 24. The tubes 25 function to hold the blade 23 against movement in the axial direction of the shaft 24. Other arrangements could be adopted for that purpose.

The angular or rotational disposition of each blade 23 as shown by Figure 5 is not necessarily the position adopted when the discs 21 are at rest. The blade dispositions as shown by Figure 5 have been adopted for convenience of illustration.

Each pivot shaft 24 is located radially outwards from the rotational axis of the drive shaft 22, and may extend through each of the discs 21 as shown by Figure 5. It is preferred that the pivot shafts 24 are arranged in substantially

equally spaced relationship around an imaginary circle that is substantially coaxial with the drive shaft 22. The number of pivot shafts 24 can be selected to suit requirements, but six such shafts have been successfully employed in one application of the invention.

5 In the particular arrangement shown by Figure 5, each cutter blade 23 is similar to the blades used in grass mowers, but other types of blades 23 could be used. Each blade 23 has one end rotatably mounted on a respective one of the pivot shafts 24, and has one or more cutting edges 26 at the other (outer) end. An outer corner portion of the blade 23 may be upturned as shown by
10 Figure 6. A cutting edge 26 may be provided along each exposed edge of that upturned portion 27, and further cutting edges 26 may be provided along the extreme outer edge of the blade 23, and also along an outer portion of the blade side edge 28. Other arrangements could be adopted to suit requirements.

 In the arrangement shown, sheets or blocks 29 (Figure 7) of polyethylene
15 (for example) are fed into the apparatus so as to enter a treatment zone 30 formed between the discs 21 and a screen 31. The depth of the treatment zone can be selected to suit requirements. In one application of the invention the depth of the zone 30 is selected so that the distance "D" between the tip of a blade 23 and the screen 31 (see Figure 8) is in the range 2.5 to 3mm. A sheet
20 or block 29 located within or approaching the zone 30 is exposed to impact by the blades 23 and is thereby reduced to particles 20, which pass through openings 32 in the screen 31.

 In the arrangement shown by Figures 5 and 7, the screen 31 functions as a sieve, and also functions as a boundary of the zone 30. Other arrangements
25 could be adopted. By way of example, the screen 31 may be located remote from the zone 30, and another member could provide the boundary of the zone 30.

 The apparatus as shown diagrammatically by Figure 7 includes a cylindrical hollow housing 33, part of which is formed by the screen 31. The
30 sheets or blocks 29 enter the housing 33 through an inlet opening 34, and are reduced into particle size as described above. As shown, the discs 21 rotate in the direction in which the sheets or blocks 29 move through the zone 30, and that may result in the sheets or blocks 29 being drawn too quickly through the zone 30. In order to counter that effect the speed of movement of the sheets or

blocks 29 into the zone 30 may be controlled by appropriate feed means. In other arrangements, the discs 21 may rotate counter to the direction of movement of the sheets or blocks 29, in which event some other form of feed means may be required. Also, alternative to what is shown by Figure 7, the housing 33 may be provided with an exit opening for passage of residue unable to pass through the screen 31.

It is preferred that the particles 20 are of relatively small size, but neither the size nor the shape of the particles needs to be regular or consistent. Avoidance of overly large particles 20 may be achieved by use of a separating sieve, such as the screen 31, or similar device. That is, in the example shown by Figure 5, particles that pass through the screen 31 are acceptable, whereas particles that do not pass through the screen 31 are not acceptable. The non-acceptable particles may be subjected to further processing in order to reduce them to an acceptable size.

Figure 9 shows, in diagrammatic form, one type of sieve opening 32 that may be used in the screen 31, for example. In the example shown the shape of each opening 32 is substantially hexagonal, but other shapes could be adopted. Satisfactory results have been achieved with openings 32 in which the distance between opposite flat sides 36 of the opening 32 is approximately 16mm, and the distance opposite corners is approximately 21mm. Other dimensions could be used, and the distance need not be the same for each of the three pair of sides 36, or for each of the three pair of corners.

The openings 32 are preferably formed in a manner such that the edges of each opening 32 are jagged or rough. It has been found that jagged or rough edged openings 32 assist in producing particles 20 having rough surfaces, which as previously stated is a desirable characteristic of the particles 20. The rough surfaces of the particles 20 assists retention of the particles 20 within the soil matrix, and also assists formation of a connection between the particles 20 and the root structure of grass and/or other vegetation. The jagged or rough edges of the openings 32 tend to catch the polyethylene sheet or block 29 and thereby promote tearing of the sheet or block 29 such that the desired rough surfaces are produced on the particles 20.

The openings 32 may be produced by a punching operation so that each opening 32 has rough or jagged side edges. Other techniques could be used to

produce the same result. Assuming use of a punching operation, the plate or sheet used to form the screen 31 may be initially provided with a series of regularly spaced and relatively small holes 37 as shown by Figure 10. Each opening 32 is subsequently produced by punching out a substantially hexagonal section of material 38 having a hole 37 at each of its corners, as also shown by Figure 10. The punching operation tends to produce a jagged edge along each side 33 of the opening 32, and also tends to produce a jagged edge 39 (Figure 9) at the junction of each side 36 and the remnants of a hole 37. It will be appreciated that satisfactory results could be achieved with openings 32 of other shapes produced by the same or different method. It is generally prepared however, that the openings 32 are of irregular shape.

An alternate form of apparatus for producing particles 20 is illustrated in Figure 21. The apparatus illustrated includes a slicing means 240 and a mulching means 241 located adjacent the slicing means 240. Bulk foamed material normally in sheets or blocks is fed to the slicing means 240 which is operable to slice the bulk material into strips. The stripped material is fed to the mulching means 241 to mulch the stripped material into particles of predetermined size. The particles are deposited into conduit system 242 and moved there along by an impeller (not shown) to a storage hopper (not shown).

Referring still to Figure 21 the slicer means 240 illustrated includes a plurality of slicing discs 245 each separated by a boss 243 (see Figure 21) on opposing shafts 244. The discs 245 interleaf and overlap, which is best illustrated in Figure 22. Whilst the degree of overlap of the discs 245 shown in Figure 22 extends to the boss 243, a lesser overlap may also be suitable.

Figure 22 illustrates the discs 245 located in a slicing zone 246. A plurality of fingers 247 extends between the discs 245 to facilitate separation of the sliced material from the slicing discs 245. The discs 245 preferably rotate in opposite directions at substantially the same speed. In this regard speeds of approximately 120 to 160 rpm have been found suitable.

Referring still to Figure 22 the sliced material is supplied to the mulching zone 248 and more specifically presented to a pair of counter rotating mulching discs 249. Each mulching disc includes a negatively raked tooth to facilitate mulching the sliced material and also facilitating raising material from a lower position in the mulching zone to an upper positing in the mulching zone 248.

Each mulching disc is separated by a boss (not shown) to allow the mulching discs to interleave. The mulching zone is defined by an external perimeter in the form of a sieve which permits mulched material to pass through the sieve once it has been mulched to a predetermined size.

5 Figure 22 illustrates a mulching means having a primary mulching zone 248 and a secondary mulching zone 250. The two mulching zones are substantially identical with the exception being the nominal diameter of the sieve size of the primary mulching zone is larger than the nominal sieve size for the secondary mulching zone 250. It should be appreciated that a primary and
10 secondary mulching zone is merely preferred and that the invention may be satisfied by a single mulching zone.

 The counter rotating mulching discs preferably rotate at differing speeds. More specifically it is preferred that one mulching disc rotate at a half to a third of the speed of rotation of the opposing mulching disc. In this regard speeds of
15 240 rpm to 80 rpm have been found most preferred.

 In one example application of the invention it has been found satisfactory to produce particles 20 from a 3mm thick sheet 29, and which particles have an approximate length of 25mm and an approximate width of 20mm. Such particles 20 have been produced using the apparatus of Figure 5, and using a
20 screen having openings 32 as described in relation to Figures 9 and 10. In such cases the reduction process used to produce the particles 20 also tends to produce smaller particles, including fines, and those smaller particles and fines can be usefully employed in this or other applications of the invention.

 The dimensions referred to in the preceding paragraph have been found
25 satisfactory in circumstances where the resilient particles 20 are to be used in a surface layer, or a sub-surface layer, of a race track or the like. Other dimensions and/or sieve opening shapes could be employed to suit other applications of the particles, and other circumstances of use. By way of example, relatively small particles, down to fines, could be used in some
30 applications. In addition, for some applications and/or circumstances of use there may be a benefit in using a mixture of particles of different sizes. That is, there may be a mixture of relatively large and relatively small particles, the ratio of which could be selected to control the amount of rebound energy of the material containing those particles.

The intermediate layer 2 may also include the other additives as used in upper layer 1 such as organic material, wetting agents, fertilisers and the like.

5 The base layer 3 may be essentially a layer of soil. Preferably, the layer 3 is composed of sand or a sand composite that functions to regulate drainage of water away from the overlying intermediate layer 2. Ideally, the drainage characteristics of the base layer 3 are such that excessive saturation of the overlying layers 1 and 2 is avoided, whilst at the same time ensuring retention of a suitable level of moisture in those layers.

10 The multi-layered group 1, 2 and 3, may overlay a base of clay or other suitable material. In some applications, the surface layer 1 may be omitted, and in other applications the intermediate layer 2 may be omitted whilst the surface layer 1 is retained.

As indicated above, the base for the multi-layer to Group 1, 2 and 3, or a variation thereof, may be formed of clay. Other impervious or semi-pervious materials could be used instead of clay. Also, in some circumstances (eg., areas of high rainfall) the base material may be selected so as to have a degree of porosity such as to enable sufficiently rapid dispersal of moisture through the base. Use of such permeable material may not be required if there is provision for collecting and re-using moisture that reaches the base.

20 In circumstances where a clay or other impervious, or semi-impervious, base is used, appropriate steps may be taken to ensure drainage of excess water from that base. That may be achieved by providing drainage tubes or channels within the clay base, and well known techniques can be used for that purpose. Also, a layer of screenings may be provided over the top of the clay base so as to intervene between that base and the surface layer or layers overlying the base. By way of example, the screenings may be approximately 7mm in size, and the screening layer may be approximately 70mm thick. Other dimensions could be selected to suit particular applications and particular circumstances of use.

30 Figure 11 illustrates, in diagrammatic form, one possible arrangement of a drainage system for use with a clay or other impervious base 40. The system includes use of pipes or tubes 41 of a well known kind having apertures or slots 42 to permit passage of water through the wall of the tube 41. A layer of screenings 43 is provided above, at each side, and below of each tube 41. In a

preferred arrangement the body of screenings 43 is at least substantially composed of stones, pebbles, or the like, having a smooth or rounded surface. Screenings of that kind have the benefit of leaving gaps within the body of screenings 40 that permit passage of water. Jagged or rough edged screenings
5 are more likely to fit together in such a way as to trap material having the tendency to block passage of water. A layer of screenings 44 may be provided over the top of the base 40, and that layer also may be at least substantially composed of screenings as described above.

Each tube 41 may be a circular tube approximately 100mm in diameter,
10 but other shapes and dimensions could be adopted. The depth of the screenings layer 43 beside, above and below the tube 41 may be approximately 100mm in each case, and again other dimensions could be adopted. The screenings layer 44 may be approximately 70mm thick as previously indicated.

Water drained from the clay or other base may be collected in a suitable
15 holding facility (eg., tank or dam) for re-use as required. The same conservation technique may be used in respect of surface run-off and excess water drained from other regions of an installation employing a surface layer or layers according to the invention.

The soil based material described above can be produced off-site, or on-
20 site, according to requirements. In the former case, any appropriate method may be used to transport the material to the relevant site and to deposit the mix at that site.

The fibres 5 in the surface layer 1 have several benefits. The fibres 5 strengthen the layer and thereby reduce deterioration due to impact and other
25 loading. The fibres 5 also improve the sustainability of the grass by minimising root shear and promoting regeneration of the grass after damage however caused.

When used in the intermediate layer 2, the fibres 5 strengthen the layer 2 and also have a stabilising influence on the resilient particles 20 such that
30 migration of those particles within the soil matrix 4 is prevented or minimised. Eventual penetration of grass roots into the layer 2 has a similar stabilising influence.

The resilient particles 20 in the intermediate layer 2 have the benefit of providing the surface layer 1 with a "bounce-back" or cushioning characteristic.

A horse, for example, running on the surface layer 1 is therefore likely to suffer minimal stress due to impact with the surface layer 1. In addition, the cushioning characteristic enables the surface layer 1 to reform after impact so as to remove or reduce indentations formed in that layer by impact or other
5 loading. That is, expansion and contraction of the particles 20 inhibits, or prevents, compaction of the soil.

Yet another benefit of the resilient particles 20 is their ability to function as a sponge for retention of fertilisers and other nutrients, for example. In addition, grass roots tend to bond with the particles 20 thereby promoting
10 maintenance of the grass carpet formed over the surface layer 1.

It will be appreciated from the foregoing that a soil based material according to the invention has important benefits when used in any of a variety of applications. Each of the soil based layers 1 and 2 hereinbefore described is an individual example of the soil based material according to the invention, and
15 each can be used independently of the other in appropriate circumstances. As previously stated however, a soil based material according to the invention may have a composition different to that described in relation to either the surface layer 1 or the intermediate layer 2 described above.

Soil based material according to the invention has numerous
20 applications. A soil based material as described above in relation to the surface layer 1 has a high degree of stability and can be beneficially used in locations, such as paddock gateways, that are subjected to a relatively high incidence of traffic and/or high loading. Other agricultural uses include farm tracks, animal holding yards, calving paddocks and animal drinking and feeding areas, for
25 example. The soil based material could be used to stabilize road and other carriageway surfaces, and could be usefully applied around watering facilities such as dams and troughs that are subjected to heavy use. Other applications are clearly available. The foregoing applies whether or not the soil based material provides a growing medium for grass, or other vegetation.

30 The above comments also apply to the soil based material described of in relation to the intermediate layer 2. That mix however, has particular benefit in circumstances requiring a surface that is substantially self-restoring in that depressions caused by scattered impact loading tend to reduce, or substantially disappear, due to the natural resilience or "bounce-back" quality of the mix.

A three layer arrangement as described above in relation to Figure 1 of the drawings is particularly useful when used as the running surface of a horse racing track, for example.

The soil/fibre mix (eg., layer 1 as previously described) without grass can be used to form the surface of a track subjected to impact or compressive loads. In such circumstances, deterioration of the track surface can be prevented or minimised by applying an embossed pattern to that surface.

By way of example, the embossed pattern may be a "herringbone" pattern or a chevron pattern, involving a series of alternating ridges and valleys. Such a pattern could be created by use of a suitably formed roller for example, or a series of tyres having a suitable tread pattern. It is preferred that the ridges and valleys extend at an angle relative to the longitudinal edge of the track. It is further preferred that the angle is an angle other than 90° so as to minimise the speed or rate of water run-off towards the edge of the track.

Such a surface pattern can function to minimise run-off of surface water and thereby promote maintenance of a suitably moist track, and could be applied to the entire surface of a track or to portions only of the track. The pattern also minimises wind induced erosion of the track surface. Soil blown from the top of the ridges tends to collect and be retained within the valleys. The surface pattern can be restored to its maximum effectiveness by occasional re-application of the patterned roller, for example. The frequency of such maintenance treatment may of course vary according to circumstances.

Figure 12 illustrates, in diagrammatic form, one particular method of producing the embossed pattern referred to above. In the example shown, a series of closely packed wheels 45 is arranged for rotation about an axis 46. Each wheel 45 has a rubber tyre 47 having treads 48 arranged substantially as shown by Figure 12. A feature of the treads 48 as shown is their angular disposition and the presence of an overlap at their inner ends 49. It will be appreciated that other tread arrangements could be employed. The tyres 47 are preferably inflated to a relatively high pressure, and may be connected to a carriage (not shown) that has a weight such as to ensure that the tyre treads 48 penetrate into the surface of the soil layer to create the embossed pattern.

The number of wheels 45 within the series can be selected to suit requirements. Also, two or more series of wheels 45 could be arranged in tandem, and an example of such an arrangement is illustrated by Figure 13.

5 In the example arrangement, shown by Figure 12, the tyres 47 are approximately 660mm wide, and each tread 48 produces a furrow or channel in the soil approximately 25mm in depth. It is to be understood however, that those dimensions are not essential, and other dimensions could be satisfactorily employed.

10 Although Figure 12 shows the direction of the tread slope to be the same for all tyres 47, that is not necessary. Some wheels 45 within the same series may be arranged differently to the other wheels of the series so that an irregular pattern is formed in the soil surface. Alternatively, the series of wheels 45 may be moved in different directions over selected portions of the surface.

15 The pattern may be arranged in accordance with the direction in which the soil surface slopes and/or in accordance with the direction of the prevailing wind to which the soil surface is exposed. Different arrangements may be selected according to whether the main objective is to promote run-off of surface water, or to minimise wind erosion of the ridges of the pattern.

20 A surface having a pattern as described above has the further advantage of reducing impact stress on the legs of horses, for example, running over that surface. That is, the ridges of the pattern tend to collapse beneath the horses hooves so as to absorb some of the impact load.

25 The space between adjacent wheels 45 could be less than or greater than that indicated by Figure 12. In the case of a multi-series arrangement as illustrated by Figure 13 however, it is preferred that the space 50 between adjacent wheels 45 is less than the width of the tyres 47. That is because in such a multi-series arrangement it is preferred to overlap the wheels 42 as shown in Figure 13 so as to ensure maximum application of the embossed pattern.

30 Figures 14 to 18 illustrate a preferred embodiment of the invention in diagrammatic form. Referring firstly to Figure 14 there is illustrated a prime mover 100 is operative to pull an assembly 101 over the ground. The prime mover 100 and the assembly 101 are joined through a connection 102, which may or may not be releasable.

The prime mover 100 may provide drive means for operating the various components of the assembly 101. Alternatively the assembly 101 has its own drive means. Another alternative is that each component has its own drive means. It should be appreciated that where hereinafter a specific component is described as having its own motor or drive means, that component may source drive means from the assembly or prime mover.

The assembly 101 includes storage means 103 for the fibres or any of the other additives, flow inducing means 104, separation means 105, a mixing chamber 106 and soil engaging means 107. The prime mover 100 is shown as having two sets of ground engaging wheels 108, but the number of wheel sets could be greater than two or less than two. The same applies to the assembly 101 which is shown as having two sets of ground engaging wheels 109.

In the example shown, the flow inducing means includes a rotatable device 110 mounted in a chamber 111. The arrangement is such that rotation of the device 110 induces air to flow in a direction from the storage means 103 towards the mixing chamber 106. The device 110 as shown includes an upstanding rotatable shaft 112 and a drive motor 113 connected to the shaft 112 and being operable to cause rotation of the shaft. Each of a number of elements 114 is connected to the shaft 112 to rotate therewith, and the arrangement is such that rotation of the elements 114 induces air to flow in the direction as described above. Other arrangements could be adopted.

The storage means 103 has an exit opening 115 that can be selectively opened and closed through operation of an appropriate valve 116 for example. When the valve 116 is open and the shaft 112 is rotating, the induced air flow draw fibres from the storage means 103 and causes a stream of those fibres to flow through a manifold 117 and from there into the mixing chamber 106. As shown diagrammatically by Figure 101, the manifold 117 may have a number of entrance ports 118, and it may have the same or a different number of exit ports 119.

In the particular arrangement shown, each of the elements 114 is formed by a length of metal chain. The rotating chains impact on the fibres flowing upwardly through the chamber 111. Such impact tends to induce an electrostatic charge in the fibres, and that has the consequence of encouraging individual fibres to separate from one another.

The ground engaging means 107 is preferably formed by a series of rotatable discs 120 that extends substantially across the width of the mixing chamber 106. A motor or other suitable drive means 121 is drivably connected to the discs 120 so as to be operable to cause those discs to rotate in the direction of arrow A (Figure 14). The speed of rotation can be selected to suit particular conditions, including (for example) the speed with which the assembly 101 is moved over the ground surface 122. It is preferred that means be provided to enable adjustment of the depth to which the discs 120 penetrate into the ground surface 122. One suitable adjusting means is shown by Figure 16, and that includes a pivoted link system 123 connected between the discs 120 and a support, and a pneumatic or hydraulic system 124 that is operable to alter the disposition of the link system 123. The axis of rotation of the discs 120 is transverse to the direction of motion of the prime mover 100. The axis of rotation may be at a right angle or at some other transverse angle.

The discs 120 may be constructed (see Figure 18) with one or more blades 150 extending transversely to the plane of the disc 120. Referring again to Figure 14 when the discs 120 are rotated while penetrating beneath the ground surface 122, they function to lift soil from below the surface 122 and cause that soil to flow upwards into the mixing chamber 106 as indicated by the arrow B (Figure 14). In that regard, it is relevant that the mixing chamber 106 as shown is open, or substantially open, at its lower side adjacent the ground. Fibres entering the mixing chamber 106 from the manifold 117 collide with the upwardly flowing soil and tend to mix with the soil. The resulting soil/fibre mix is represented by the arrow C in Figure 14. As shown, the soil/fibre mix is induced to flow downwardly on to the ground surface 122 at a location rearward relative to the ground engagement means 107. The arrangement is such that the rotating discs 120 cause the downwardly flowing soil/fibre mix to mix with loose soil at and below the surface 122.

The flow of soil, fibre, and soil fibre mix, within the mixing chamber 106 can be controlled in any suitable manner. In the arrangement shown a flexible skirt 125 depends from the lower edge of the chamber 106 and engages the ground surface 122. Escape of air from the chamber 106 is thereby prevented, or at least hindered. Control means (not shown) may be provided to enable adjustment of the skirt 125 in a manner such as to increase or reduce the

potential for air to escape preferably at the rear lower side of the chamber 106. Other escape means may be acceptable. Such control can be utilised to vary the soil to fibre ratio in the final soil based product.

Other control means could be utilised for that purpose. In the arrangement shown an adjustable exhaust vent 126 is provided in a wall of the mixing chamber 106. It is preferred, as shown, that the vent 126 communicates with an air space 127 within the chamber 106 and which in turn communicates with the general interior of the chamber 106. In the example shown, the air space 127 is formed behind a flexible deflectable wall section 128 arranged to promote appropriate directional movement of the downwardly flowing soil/fibre mix.

Whilst Figure 14 diagrammatically illustrates a substantial space between an inner surface of the chamber 106 and upper perimeter of the disc 120, the chamber 106 may be provided with more or less space. It is desirable to provide for less space than that illustrated to improve the flow and mix characteristics.

The roller 129 at the back of the assembly 101 corresponds to the roller 17 shown in Figure 3.

The storage means 103 can be divided into a number of separate compartments 130, 131 and 132 (Figure 17), by way of example only. The number of compartments may vary according to requirements. In the example shown, the compartment 131 might be used to store fibres, the compartment 130 might be used to store particles of resilient material, and the compartment 132 might be used to store fertiliser. Accordingly a reference hereinbefore to a soil/fibre mix or to fibres may vary according to the content of the storage means 103 or a compartment 130, 131, 132 of the storage means. Other arrangements are clearly possible. The exit opening 115 of each compartment 130, 131 and 132 can be controlled by a valve 116 as previously described. Each of those valves 116 could be connected to metering means 133 operable to control the ratio of materials fed through the metering means 133.

Figures 19 and 20 illustrate an alternate preferred embodiment of the apparatus according to the invention where same reference as used hereinbefore refer to like elements. The prime mover 100 illustrated in Figure 20 pulls the mixing chamber 106 over the ground, while the storage means 103,

separation means 105 and flow inducing means 104 are located forward of the prime mover 100. The operation of the mixing chamber 106 and associated apparatus is as for the embodiment shown in Figures 14 to 18 which is shown in Figure 19 merely for completeness.

5 Referring now in particular to Figure 20, the storage means 103 includes an agitator 220 to agitate the fibre or particles towards a feed auger 221. The agitator 220 reduces the propensity for the fibres to bridge or stack before the feed auger 221. The preferred agitator illustrated includes a rotatable shaft 223
10 having a plurality of agitating arms 224 extending therefrom. Rotation of the shaft 223 causes the arms 224 to break up and agitate the fibres or particles so that they are encouraged to move towards the feed auger 221.

The feed auger 221 is used to control the rate of supply of fibres or particles to the separation means 105. The preferred feed auger illustrated includes a rotatable shaft 225 with a continuous helical blade 226 for movement
15 with the shaft 225. The speed of rotation of the shaft 225 is adjustable to adjust the rate of supply. The direction of rotation of the shaft 225 is also adjustable to feed in one direction and unfeed or unblock in the opposite direction.

Fibres or particles supplied to the separation means 105 are treated in accordance with the previous preferred embodiment illustrated in Figures 14 to
20 18 with the exception that progression of fibres or particles through the chamber 111 is assisted by a blower 228. The fibres or particles are supplied to supply conduits 229 linking the separation means 105 with the mixing chamber 106.

The illustrated embodiment in Figure 20 has the motor 113 rotating the shaft 112, and through a gear box 230, rotating the shaft 225 of the feed auger
25 221. Clearly other drive arrangements are possible.

Whilst Figure 20 does not illustrate a corresponding storage means, it is envisages that storage hoppers could be positioned above the agitator 220.

Various alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without
30 departing from the spirit or ambit of the invention as defined by the appended claims.

CLAIMS:

1. A soil based material including a soil matrix and synthetic fibres scattered throughout said matrix.
2. A soil based material according to claim 1, wherein said fibres are a
5 mixture of mono-fibres and fibrillated fibres.
3. A soil based material according to claim 2, wherein said mixture of fibres includes substantially even amounts of said mono-fibres and said fibrillated fibres respectively.
4. A soil based material according to claim 3, wherein each cubic metre of
10 the soil matrix includes 1 to 6 kilograms of said mixture of fibres.
5. A soil based material according to claim 4, wherein each cubic metre of the soil matrix includes approximately 2.6 kilograms of said mixture of fibres.
6. A soil based material according to claim 1, wherein said fibres are mono-fibres, and each cubic metre of said soil matrix includes approximately 17
15 kilograms of said fibres.
7. A soil based material according to any preceding claim, wherein biodegradable fibres, in addition to said synthetic fibres, are scattered throughout said soil matrix.
8. A soil based material according to any preceding claim, wherein at least
20 some of said fibres have a length in the range 15 millimetres to 20 millimetres inclusive.
9. A soil based material according to any preceding claim, including at least one additive dispersed throughout the matrix.
10. A soil based material according to claim 9, wherein said additive
25 comprises or includes an organic material fertiliser or wetting agent.
11. A soil based material according to claim 9, wherein said additive comprises or includes particles of resilient material scattered throughout the soil matrix.
12. A soil based material according to claim 11, wherein said particles are
30 approximately 3 millimetres thick, approximately 25 millimetres long, and approximately 20 millimetres wide.
13. A soil based material according to claim 11 or 12, wherein said particles are formed of polyethylene.

14. A method of producing a soil based material including a soil matrix and synthetic fibres scattered throughout said matrix, including the steps of depositing said fibres on the surface of a body of soil, and mixing said fibres with said body of soil to achieve a substantially regular dispersion of said fibres throughout said body of soil.
15. A method according to claim 14, wherein said fibres are caused to separate prior to being deposited on said body of soil.
16. A method according to claim 15, wherein said separation is effected by inducing an electrostatic charge in said fibres.
17. A method according to any one of claims 14 to 16, including the step of mixing particles of a resilient material with the soil matrix so as to achieve a substantially consistent dispersion of said particles throughout said matrix.
18. A method according to claim 17, wherein said particles are mixed with the soil matrix prior to introducing said fibres into said soil matrix.
19. A method according to claim 17, wherein said particles and said fibres are simultaneously mixed with said soil matrix.
20. A method of producing a soil based material including the steps of, moving a mixing chamber over the surface of a body of soil, causing soil to be lifted from said surface to flow upwards into said chamber, directing a stream of fibres into said chamber so as to mix with said upward flow of soil, directing said soil/fibre mixture to flow downwards within said chamber towards said body of soil at a position rearwards of said upward flow of soil relative to the direction of travel of said chamber, and mixing said soil/fibre mixture within said body of soil.
21. A method according to claim 20, wherein said fibres are caused to separate prior to being deposited on said body of soil.
22. A method according to claim 21, wherein said separation occurs before said fibres enter said mixing chamber.
23. A method according to claim 21 or 22, wherein said separation is effected by inducing an electrostatic charge in said fibres.
24. A method according to any one of claims 20 to 23, wherein an additive is introduced into said stream of fibres to mix therewith before said stream enters said mixing chamber.

25. A method according to claim 24, wherein said additive comprises particles of a resilient material, and both said fibres and said particles are mixed with said upward flow of soil within said mixing chamber.

26. A ground surface including a surface layer and a second layer underlying
5 the surface layer, said surface layer including a soil matrix and synthetic fibres scattered throughout said matrix, and said second layer including a soil matrix, synthetic fibres scattered throughout the soil matrix of the second layer, and particles of resilient material scattered throughout the soil matrix of the second layer.

10 27. A ground surface according to claim 26, wherein said surface layer is formed of a soil based material according to any one of claims 2 to 13.

28. A ground surface according to claim 26 or 27, wherein said second layer is formed of a soil based material according to claim 12 or 13.

15 29. A ground surface according to any one of claims 26 to 28, wherein said second layer is interposed between said surface layer and a base layer.

30. A ground surface according to claim 29, wherein said base layer is composed of sand or a sand composite.

20 31. Apparatus for forming a soil based material according to any one of claims 1 to 13, said apparatus including a delivery system through which a stream of said fibres is moved, separation means promoting separation of individual fibres in said stream, and mixing means operative to mix said fibres within a body of soil that forms said soil matrix.

32. Apparatus according to claim 31, wherein said separation means induces an electrostatic charge in said fibres.

25 33. Apparatus according to claim 31 or 32, including storage means in which said stream of fibres is deposited downstream from said separation means, and from which fibres are extracted for delivery to said mixing means.

30 34. Apparatus according to claim 31 or 32, wherein said mixing means includes a mixing chamber for receiving said stream of fibres downstream from said separation means, and soil engaging means operative to lift soil from a body of soil beneath said mixing chamber and cause the lifted soil to mix with said fibres within said mixing chamber, and said mixing chamber includes flow directing means that directs the soil/fibre mix to flow downwards onto said body of soil.

35. Apparatus according to claim 34, including storage means for containing a body of said fibres, and flow inducing means for causing fibres to exit said storage means and flow towards said mixing chamber.
36. Apparatus according to claim 35, wherein said flow inducing means is
5 formed by or includes said separation means, and said separation means is located between said storage means and said mixing chamber.
37. Apparatus according to claim 35 or 36, wherein said storage means includes a plurality of compartments, one of which is a storage compartment for said body of fibres, and each said compartment has an exit port that can be
10 selectively opened or closed.
38. Apparatus according to claim 37, wherein another of said compartments is a storage compartment for a body of particles of resilient material, and said flow inducing means is operative to cause particles to exit said particle storage compartment when the exit port of that compartment is open.
- 15 39. Apparatus according to claim 38, including metering means operative to control the ratio of said fibres and said particles when said fibres and said particles are being simultaneously extracted from their respective said compartments.
40. Apparatus according to claim 39, wherein said metering means is
20 adjustable to vary said ratio.
41. Apparatus according to claim 34 including a feed auger being operable to supply said fibres and particles to the separation means, the feed auger being rotatable about an axis, the speed of rotation being adjustable to adjust the rate of supply of fibres and particles to the separation means.
- 25 42. Apparatus according to claim 40 including storage means for containing a body of said fibres or said particles and agitation means for agitating said fibres or said particles to move towards the feed auger.
43. Apparatus according to claim 40 or 41 including flow inducing means for inducing fibres or particles to exit the separation means.
- 30 44. Apparatus according to claim 42, wherein the flow inducing means is an impeller located between the separation means and mixing chamber.
45. Apparatus according to any one of claims 34 to 44, wherein said mixing chamber is movable across said body of soil.

46. Apparatus according to claim 45, wherein said mixing chamber forms part of an assembly including the following components said soil engaging means, said storage means, said flow inducing means, said separation means, and said metering means.
- 5 47. Apparatus according to claim 46, including prime moving means for moving the assembly relative to the body of soil.
48. Apparatus according to claim 47, wherein the prime moving means is separable from the assembly.
49. Apparatus according to claim 48, wherein the prime moving means
10 provides drive means for the operation of the components of the assembly.
50. Apparatus for processing bulk foamed material to produce particles of predetermined size including:
- a slicing means including a plurality of slicing discs being operable to process the bulk material into strips;
- 15 a mulching means including a plurality of mulching discs being operable to process the sliced material into particles of predetermined size; and
- a sieve defining at least in part a mulching zone within which the mulching discs operate, the sieve permitting material of a predetermined size to pass therethrough.
- 20 51. Apparatus according to claim 50, wherein the slicer discs are located on opposing shafts, the shafts being rotatable in opposite directions.
52. Apparatus according to claim 51, wherein the speed of rotation of each shaft is adjustable so as to adjust a speed at which sliced material is discharged from the slicing means.
- 25 53. Apparatus according to claim 51 or 52, wherein each slicing disc on each shaft is separated by a boss of substantially similar thickness, the opposing shafts being positioned such that the slicing discs on opposing shafts interleave and overlap.
54. Apparatus according to any one of the preceding claims, wherein each
30 mulching disc on each shaft is separated by a boss of substantially similar thickness to the mulching disc, the opposing shafts being positioned such that each mulching disc on opposing shaft interleaves.
55. Apparatus according to any one of the preceding claims, wherein each mulching disc includes a tooth which is negatively raked to facilitate mulching of

the stripped material and movement of the material from a lower position within the mulching zone to an upper position in the mulching zone.

56. Apparatus according to claim 54, wherein the speed of rotation of one shaft is approximately one half to one third speed of rotation of the other shaft.

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